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Abstract
This document provides procedural instructions for the Final Status Survey of the 17th Street Drainage Area at the Santa Susana Field Laboratory. This procedure complies with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

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1.0 INTRODUCTION

The Final Status Survey conducted by Rocketdyne Propulsion and Power for the 17th Street Drainage Area will follow the protocols of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Reference 7.1. The format of this plan follows closely the format suggested in Appendix A of Reference 7.1. The objective of this survey is to demonstrate that no residual contamination remains that could result in unacceptable exposure or risk to current or future occupants.

2.0 FACILITY HISTORY

2.1 Background

At Rocketdyne Propulsion and Power, Santa Susana Field Laboratory, a natural rainwater channel is located in Area IV, south of the intersection of "G" Street and 17th Street. In 1962, a berm was constructed around the channel to provide a 30-ft. by 30-ft hold-up pond. The pond was functional for many years. It cycled through periods of evaporative drying in summer seasons, and refilled during rainy seasons causing the low-lying area to be marshy. In subsequent years, the area became overgrown with shrubs and trees, and filled with silt.

In 1995, during the Area IV Radiological Survey, the pond area was found to be completely overgrown, marshy, and inaccessible. Soil from the drainage channels to the north and south of the pond area was sampled. No contamination was found in those locations.

In 1997, during an assessment of historical aerial photos, the existence and location of the pond was identified and investigated. Several soil samples were taken in the area (which was then dry), and two of the soil samples indicated Cs-137 at 13.5 and 14.9 pCi/g. A radiation scoping survey was subsequently conducted in the pond area, and any locations found over the background limits were identified.

In 1998, the entire drainage channel area was cleared of shrubs and trees. The original bermed pond area was mapped, gridded and surveyed, including all upper flow intake to the pond; and lower discharge drainage out of the pond. At one-meter above the ground, exposure measurements conducted did not exceed 18.4 μR/hr in a background of 15 μR/hr. Some elevated radiation measurements in localized areas at ground level were observed at a maximum of twice the background levels.

All locations exceeding ground level exposure rates of more than 5 μR/hr above background were identified and marked. All elevated radiation areas were sampled at varying depths of soil. However, most of the soil samples indicated naturally occurring radionuclides. Soil samples in areas immediately north and immediately south of the berm indicated levels of radionuclides above local background levels. Cs-137 was found at 2 pCi/g, which was less than the cleanup standard of 9.2 pCi/g. Th-228 was found at 6 pCi/g, which was close to the cleanup standard limit. Uranium isotopes were found at 4 pCi/g, which was less than the cleanup standard of 30 pCi/g. All uranium sample results showed ratios of uranium isotopes consistent with naturally occurring uranium.

There were no processed or enriched uranium isotopes found typical of the nuclear fuel used at the SSFL. Although thorium-228 was discovered at 6 pCi/g, its parent isotope thorium-232 was found at background levels of 1 pCi/g. Since this specific thorium isotope was not processed or used at the SSFL, the origin or cause of elevated thorium-228 is presently unknown.

The majority of the soil samples did not exceed cleanup standards, and did not pose a health risk, however, portions of the 17th Street Drainage area were excavated for ALARA purposes. Post excavation soil sampling showed that excavation had been effective in reducing soil concentrations much further below the cleanup standards. Prior sampling and remediation is described in Reference 7.7.

2.2 Approach

Table 1 depicts the survey and remediation schedule for the 17th Street Drainage Channel.

Initial Soil Sampling	1995
Follow-up Soil Sampling	1997
Rocketdyne Characterization Survey	September 1998
Remediation	October 1998
Post-remediation Survey	November 1998
Rocketdyne Final Survey	June 1999
ORISE Verification Survey	September 1999
DHS Verification Survey	September 1999

TABLE 1: KEY MILESTONES

3.0 SURVEY DESIGN

3.1 *Identification of Radionuclides of Concern*

The principle contaminant of concern at the 17th Street Drainage Channel area is Cs-137. No other significant isotopes were found in the environment or soil without the adjoining presence of Cs-137. Cesium will therefore be used as a tracer for all potential contaminants and MDCs for the scanning portion of the survey (*refer to Section 3.9*) based on the Cs-137 detectability. Soil sample analysis will be performed for all gamma emitting radionuclides, Sr-90, and isotopic Plutonium, Thorium, and Uranium.

3.2 Derived Concentration Guideline Limits ($DCGL_w$)

The objective of this survey is to demonstrate that residual contamination in excess of the derived concentration guideline limits (DCGLs) is not present at the site. The $DCGL_w$ for Cs-137 in soil is 9.2 pCi/g above background. Background Cs-137 in the vicinity of the site has an upper range of 0.2 to 0.8 pCi/g which is sufficiently less than the $DCGL_w$ that gross (not net or background subtracted) Cs-137 data will be used. Soil radioisotope concentrations shall be compared to the soil clean-up standards ($DCGL_w$) for all isotopes as listed in Table 4 of Reference 7.8.

3.3 Classification of Areas Based on Contamination Potential

3.2.1 Impacted Areas

The impacted area is considered to be the area within geodetic land blocks **L18 and L19** that surround the berm (*see Figure 1*). This is an area of 120 ft x 200 ft = 24,000 ft^2 (approximately 2230 m^2)

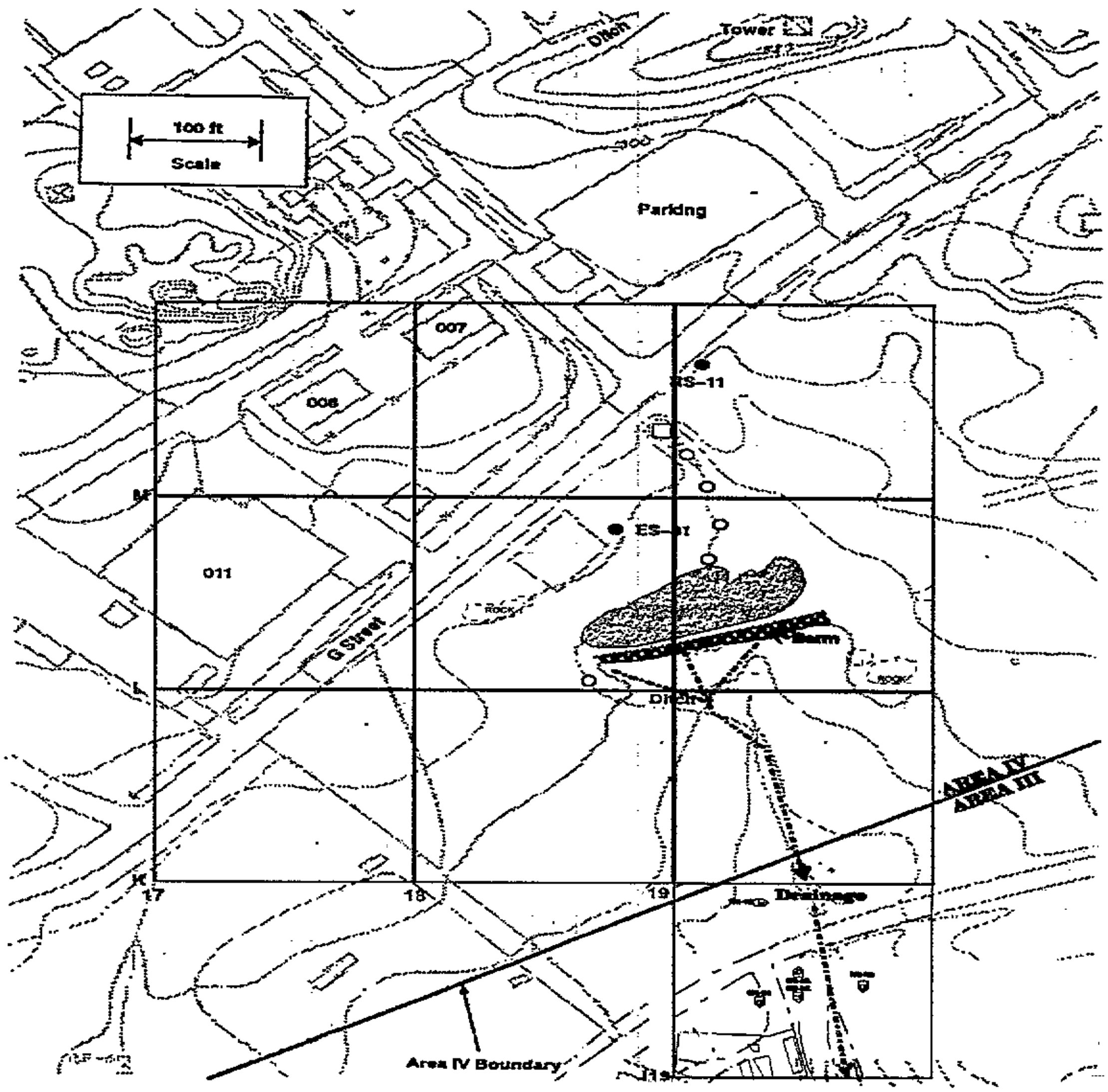

FIGURE 1: TOPIGRAPHICAL MAP OF 17TH STREET DRAINAGE CHANNEL

<u>CLASS I</u>
The impacted area is considered a Class I area. The area is enclosed within four corners identifiable by Area IV's geodetic coordinate system as:

- Block L18 located North at 0-ft and East at 120-ft,
- Block L18 located North at120-ft and East at 120-ft,
- Block L19 located North at 0-ft and East at 120-ft, and
- Block L19 located North at 120-ft and East at 120-ft.

<u>CLASS II</u>
There are no Class II areas in this survey.

<u>CLASS III</u>
There are no Class III areas in this survey

3.3.2 Non-Impacted Area

Areas surrounding the impacted area have been surveyed in earlier projects (*see Reference 7.7*) and demonstrated to be non-contaminated. These surrounding areas are not part of the survey.

3.4 Identification of Survey Units

3.4.1 Area Classification

Table 2 of the MARSSIM Manual, Roadmap-6, and limits the Survey Unit area as follows:

CLASSIFICATION	MAX SURVEY UNIT AREA
Class I	2,000 m^2
Class II	2,000 m^2 to 10,000 m^2
Class III	No limit

TABLE 2: AREA CLASSIFICATION

3.4.2 Figure 2 depicts the Class I area, which will consist of one Survey Unit of 24000- ft^2 ($2230m^2$). The diagram is just an example, and not true to scale.

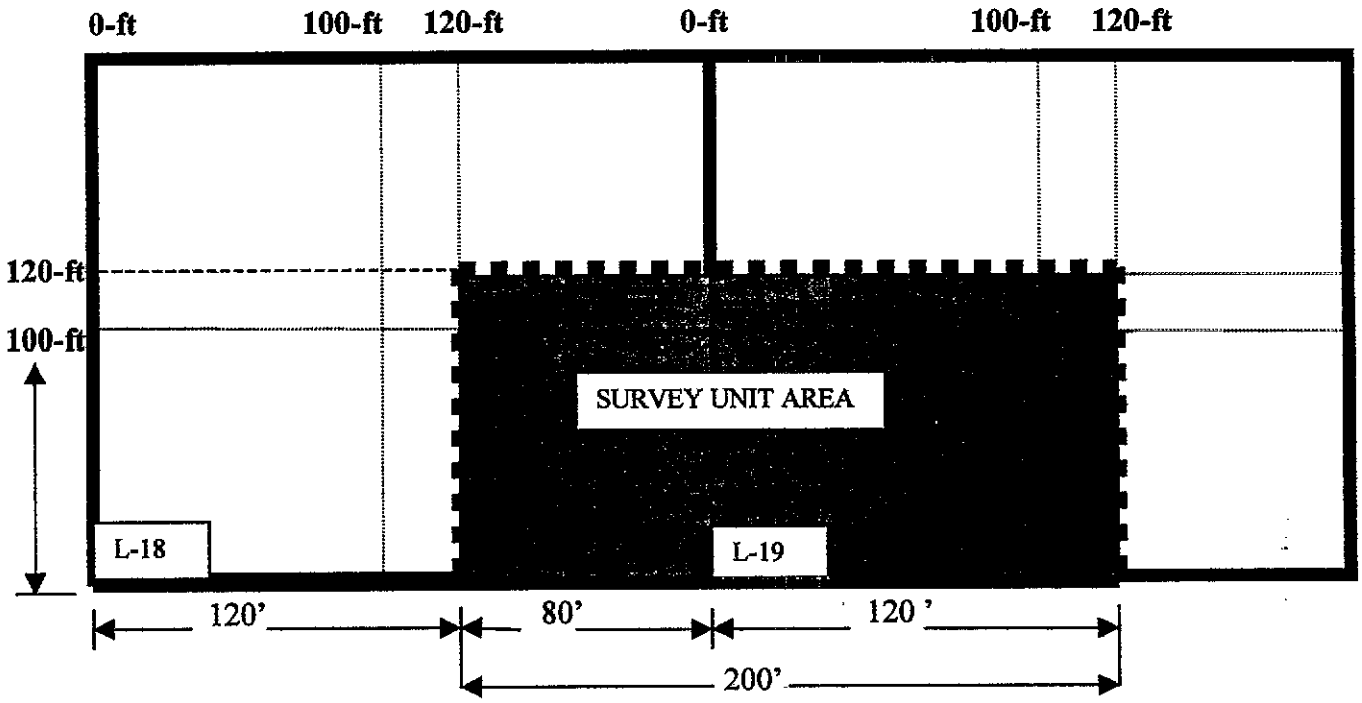

FIGURE 2: LOCATION OF SURVEY UNIT

3.5 Decision Objectives

- The objective of this survey is to achieve release of the area for unrestricted use.
- The null hypothesis (H_0) for the survey unit is that the residual radioactivity concentrations exceed the release criterion. The null hypothesis must be rejected for the site to be released for unrestricted use.
- Acceptable decision error probabilities shall be α (regulatory risk) = 0.05 and β (users risk) = 0.05. Alpha (α) is defined as the probability that the known hypothesis will be rejected when in fact it is true (e.g. *a contaminated site is declared clean*). Beta (β) is defined as the probability that the null hypothesis will be accepted when in fact it is false (e.g. *a clean site is declared contaminated*).
- The Derived Concentration Guideline Limits (DCGLw) for the primary contaminant of concern (Cs-137) shall be 9.2 pCi/g, equivalent to an annual dose to a residential user of 15 mrem/year.
- The Lower Bound of the Gray Area (LBGR) *shall be one half of the DCGLw* or 4.6 pCi/g of Cs-137.
- The regulator's risk (α) *shall be established* for the DCGLw.
- The user's (Rocketdyne) risk (β) *shall be established* at the LBGR.

3.5.1 Power Curve

The desired power curve indicates the gray region extends from 4.6 pCi/g to 9.2 pCi/g of Cs-137. The survey is designed for the statistical test to have a 95% power to decide the survey unit containing less than 4.2 pCi/g of Cs-137 meets the release criterion. For the same test, a survey unit containing over 9.2 pCi/g of Cs-137 has less than 5% probability of being released.

3.6 Area Preparation

3.6.1 Number of Survey Units

There is a total of one (1), Class I, Survey Unit of 24,000-ft^2 (or each 2230 m^2). The number of surface soil samples that will be taken is derived in Section 3.7.

Survey Unit 1 consists of 24,000-ft^2 (2230-m^2)

3.7 Analysis Procedures

3.7.1 Statistical Test

Since the gross (non-background subtracted) Cs-137 data are to be subjected to statistical test, the Sign Test will be used as recommended by MARSSIM.

3.7.2 Relative Shift

The shift Δ is the $DCGL_w$ minus the LBGR ($\Delta = DCGL_w - LBGR$). In other words, the shift is the width of the gray region. σ is the expected standard deviation of the measurements of the survey unit. Based on prior sampling of the land and excavations at the 17th Street Drainage Channel, the σ for Cs-137 is 3.39 pCi/g.

The **relative shift Δ/σ** is therefore (9.4 - 4.6)/3.39 = **1.4**

3.7.3 Number of Data Points (Soil Samples)

From Table 5.5 of Reference 1, the number of samples required for a relative shift of 1.4 and $\alpha = \beta = 0.05$ is 20. However, the Class I area (2230 m^2) is 11% larger than the recommended size of 2000 m^2. Therefore, the number of sample is adjusted accordingly to reflect this size difference. The adjusted number of samples is **22**. Locations of soil samples shall also be obtained at these locations.

Total number of sample points required for 24,000 ft^2 (2230 m^2) is 22.

3.8 Reference Coordinate System

3.8.1 Sample Point Spacing

For the Survey Unit, the grid spacing and scan area between sample points (for a square grid) are calculated as follows:

Scan Area = A = 24,000 ft^2/22 = 1090.9-ft^2 = 101 m^2
L = $\sqrt{A}$ = $\sqrt{1090.9}$= **33.02-ft** (10.06 meters) **distance apart**

In accordance with the MARSSIM Manual, *Survey Planning and Design*, page 5-38, "*Grid spacing should generally be rounded down to the nearest distance that can be measured in the field*". Therefore, the distance between sample points is 33-ft or 10 meters.

Distance (L) between sample points is 33-ft or 10 meters

3.8.2 Starting Point Coordinates

In order to designate the starting point of soil sample locations, a pair of random numbers was generated from Table 1.6 of the MARSSIM Manual, Reference 1. Rectangular coordinates from the southwest corner of the survey unit were then calculated by multiplying by the dimensions of the survey unit (120 ft x 200 ft). Survey unit coordinates will be designated as follows:

0.707773 x 200 ft = 141.5 ft (43.1 m)
0.426444 x 120 ft = 51.1 ft (15.5 m)

Starting from the southwest corner origin of the Survey Unit, the point of origin to begin measuring is:

Starting Point Coordinates
(X) East 141.5-ft (43.1meters)
(Y) North 51.1-ft (15.5 meters)

3.8.2 Spacing

In summary, a minimum of 22 soil samples shall be taken at 33-ft (or 10-m) distances apart; starting at the (E141.5-ft, N51.1-ft) or (E43.1-m, N15.5-m) coordinates.

3.9 Instrumentation and Techniques

3.9.1 Required Scan MDC

Scanning of soil sample grids will be performed to ensure small areas of contamination do not remain undetected. The $DCGL_W$ is calculated in RESRAD 5.6[1] using default of 10,000 m^2. Running RESRAD with smaller areas leads to a relatively higher release criteria. From Table 5.6 of Reference 1, the Area Dose Factor for 101 m^2 for Cs-137 is 1.4. Therefore the elevated measurement concentration $DCGL_{EMC}$ is: $DCGL_{EMC} = DCGL_W$ x Area Factor = 9.2 x 1.4 = 12.9 pCi/g

Required Scan MDC = 12.9 pCi/g

3.9.2 Actual Scan MDC

Surface scans will be performed with a 1 in. x 1 in. NaI detector moving at 1 ft/sec. Actual scan MDC for this technique is calculated below following the procedure outlined in page 6-45 of MARSSIM, Reference 1.

Background = B = 3000 counts/min
Assumed hot spot dimensions = 1.5 ft x 1.5 ft
Assumed hot spot depth = 0.5 ft
Scan speed = 1 ft/sec
Observation interval = 1.5 sec
Delectability index 1.38
Surveyor efficiency 0.5
CPM/Exposure ratio = 215 cpm per μR/h

Minimum Detectable Count Rate (MDCR) =

$$1.38 \times (3000 \times 1.5/60)^{0.5} / ((1.5/60) \times 0.5^{0.5}) = 676 \text{ counts/min}$$

Minimum Detectable Exposure Rate (MDE) = 676/215 = 3.1 μR/h

A microshield analysis was performed for the hot spot size defined above, for cesium-137 and its progeny barium-137 at a 1 pCi/g concentration and soil density of 1.4 g/cm3. The exposure rate at 2 in. from the surface was 0.3 μR/h.

Actual Scan MDC = 3.1/0.3 = **10.3 pCi/g**

Since the actual scan MDC of 10.3 pCi/g is less than the required scan MDC (or $DCGL_{EMC}$) of 12.9 pCi/g, the scanning technique is adequate for detecting hot spots above $DCGL_{EMC}$ between the soil sample locations. Therefore no adjustment to the number of soil samples to account for elevated activity is necessary.

3.9.3 Instrument Performance Check

Measurement integrity of the instruments will be monitored throughout all parts of gamma surveys by periodic checks of the instrument's response to normal background radiation, and to a *Field Check Source.* A record of these instrument checks is maintained by the daily completion of Instrument Qualification Reports.

3.9.4 Environmental Calibration Site

The location where the instrument calibration and efficiency checks will be conducted will be across the street from Area 17, in front of Building 4006. The detector is source checked at the 1-meter height, and will remain the daily source check area throughout the Area 17th Street Drainage Channel surveys.

3.9.5 Representative Reference Background Areas

Since the primary contaminant nuclide of concern and tracer is Cs-137, a reference area is not needed for this land survey. The Cs-137 will be reported as gross values and not background subtracted.

3.9.6 Ambient Survey Detector Fixtures

To accurately obtain a 1-meter ambient gamma measurement at each sample point location, the sodium iodide detector will be mounted on a lightweight PVC fixture. This fixture holds the detector oriented towards the ground at a 1-meter height. Its use facilitates quick placement at each measurement location, while eliminating errors due to detector distance or orientation.

3.9.7 Walk-about Survey Detector Fixtures

During the walk-about survey, a sodium iodide detector probe will be mounted at the end of a balanced boom, so the surveyor can sweep the probe over a large area while walking along the survey path. The fixture for this survey has a length of stainless steel tubing for the boom, with a bracket at one end to hold the detector upright to the ground, and a counterbalance weight at the other end. A shoulder strap may be attached to the balance point of the fixture. The arrangement allows the surveyor to sweep the detector over an area about 5 feet wide while walking a straight line.

3.10 Pre-survey Preparation

Brush was cleared from the survey unit prior to conducting the Final Status Survey.

4.0 PREREQUISITES

4.1 General Instructions

All personnel shall observe the following general instructions:

4.1.1 Ensure personnel working in the area are aware of the Site Emergency Plan and will implement it as required.

4.1.2 Services are available to provide first aid support when required.

4.1.3 Secure all equipment and/or materials removed from the work areas called out in this procedure at the end of each workday.

4.1.4 Record the equipment number, serial number, date of use, calibration date, and this procedure number on all radiation survey reports and all other survey information documentation specific to this survey.

4.1.5 Ensure two personnel are present while working in the 17^{th} Street Drainage Area for safety purposes.

4.1.6 If changes are necessary, redline the working copy of this Survey Procedure and obtain approval from the person in charge, the Radiation Safety Officer (RSO), Health Physics Engineer or designee Health Physics technician. In addition, changes affecting cost and scheduling must be approved and signed by the program manager (PM).

4.1.7 General training for Radiation Safety personnel is required in accordance with Reference 7.4, and outlined in Appendix B of this procedure.

4.1.8 A single designated "working copy" of this final survey procedure will be utilized at the work site, identified as *the* working copy on the cover page, and located in an area designated for working copies.

4.1.9 At the completion of all tasks covered by this procedure, the working document, including all redline changes incorporated and signed, and the required Appendices, will be filed with Radiation Safety Department in the file labeled *17^{th} Street Drainage Area Project* in Building 4487.

4.1.10 All counts collected on the scalar detector are converted to μR/hr to compare with background measurements. A potential *hot spot* is defined as 5μR/hr above background.

4.1.11 Observe if the measured gamma count rate exceeds 4300cpm on the scalar detector. If the ambient gamma activity at the potential *hot spot* was greater than 4300cpm (equivalent to 5μR/hr over the normal background), measured at a one meter height, then the location of the activity peak is marked

4.1.12 *FHP* is defined as "facility Health Physics technician" in charge of the building or field lot-decommissioning project as determined by the Radiation Safety Department.

4.1.13 *PIC* is defined as the "person in charge" of the remediation project for SHEA. This individual is typically the first line supervisor.

4.2 Equipment Checklist

The following equipment and instrumentation will be used during the conduct of the survey. Substitutions may be made where the equipment performance is essentially equivalent to the instrument listed.

4.2.1 Ludlum Model 22-21-ESG Scalar/Rate meter.

4.2.2 Ludlum Model 44-2 High-Energy Gamma Probe

4.2.3 Canberra Series 200 MCA System with High-Purity Germanium Detector.

4.2.4 Cesium 137 check source.

4.2.5 Survey detector 1-meter tripod or equivalent.

4.2.6 Survey detector balance boom.

4.2.7 (3) 200ft or 100-meter measuring tapes.

4.2.8 Wire stakes with (2) different colored flags [optional].

4.2.9 Compass.

4.2.10 Personnel protective equipment determined by the RSO.

4.2.11 Detergent and wash buckets for tool decontamination

4.2.12 Hand auger (power auger if needed)

4.2.13 Hand shovel

4.2.14 Plastic bags

4.3 Procedural Prerequisites

CAUTION: If changes are necessary, redline the working copy of this Survey Procedure (SP) and obtain approval from the person in charge (PIC), the Operations Manager (OM), and the Radiation Safety Officer (RSO) or designee Facility Health Physics technician (FHP when applicable). In addition, changes affecting cost and scheduling must be approved and signed by the program manager (PM).

NOTE (1): General training for Radiation Safety personnel is required in accordance with Reference 7.2,7.4, 7.5 and outlined in Appendix B of this procedure.

(2): A single designated "working copy" of this final survey procedure will be utilized at the work site, identified as "the working copy" on the cover page, and located in an area designated for working copies.

(3): At the completion of all tasks covered by this procedure, the working document, including all redline changes incorporated and signed, and the required Appendices, will be filed with Radiation Safety Department in the file labeled *17th Street Drainage Area Project* in building T487.

4.3.1 Verify that all of the Radiation protection technicians working to this survey procedure have been trained in accordance with Reference 7.2,7.4, 7.5 and Appendix B of this procedure.

FHP: __________

4.3.2 Verify that each employee working in the area has attended a tailgate brief to indicate their understanding of the job and instructions.

PIC: __________

4.3.3 Verify that all personnel initialing redlines for signature have signed the initial verification sheet of this procedure.

FHP: __________

4.3.4 Verify all calibration and check data are recorded on an Instrument Qualification Sheet (IQs) by the Facility Health Physics technician (FHP). Acceptance limits for daily checks shall be established for each instrument at ± 20% of the initial calibration value.

FHP: __________

4.3.5 Verify all daily instrument calibrations and checks made at the beginning of the working day, at mid-day, and at the end of the workday are conducted. The average backgrounds and efficiency factors determined at the beginning and end of each half-day shall be used with data obtained during that time period

FHP: __________

5.0 SAMPLING PROCEDURE

CAUTION: **All abnormal detector observations and readings will be reported to the Radiological Instrumentation Laboratory before taking any survey readings with the suspect instruments.**

NOTE: A geodetic *survey block* is a 200ft square, enclosing area. Four adjacent grid marker stakes define the corners of this survey block. The 200ft-grid marker stakes should be in place, and all stakes typically occur at 200ft interval, intersection points on the site Area IV location map.

5.1 Identifying Geodetic Locations

5.1.1 Notify the RSO or HP Engineer before proceeding with the survey if the geodetic marker stakes are offset, or a modification is made to accommodate the lack of true corner postmark placements.

5.1.2 Redline-mark the working procedure if a modification to the survey unit map layout is made. Changes to the procedure will be based upon the use of sighting compasses and additional measuring tapes to establish placements for the west and south boundary tapes. Alterations to the boundary layout will be specifically described on the back of the Ambient Gamma Survey Data Record.

5.1.3 Identify the survey block from the map, and locate the L-18 geodetic grid block.

5.1.4 Locate and verify the grid marker stake at the southwest corner of the geodetic block. The grid marker stake should have an internal site location code stamped on it, such as: **L-18,** identifying the CSPCS northing and easting coordinates of the location marked by that stake.

NOTE: If obstacles prevent establishing a straight boundary-to-boundary survey transect tape, and a suitable alternative for stepping around the obstacles has not been developed, consult with the HP Engineer before preceding in this survey block.

5.1.5 Lay a measuring tape from the L-18 marker stake along a line running due north, ending at the next marker stake (M-18) 200-ft (60.96 meters) north.

5.1.6 Verity that the second marker stake (M-18) is placed at a 200-ft (60.96-m) interval grid point, by reading the northing and easting coordinates from the CSPCS coordinate tag.

5.1.7 Ensure the tape is taut, not stretched, and anchored to the ground. This tape is referred to as the west boundary tape. The second stake (M-18) marks the northwest corner of the grid block being defined.

5.1.8 Leave the first measuring tape in place, and return to the L-18 southwest corner post.

5.1.9 Locate the next 200-ft (60.96-m) grid marker stake directly east at L-19.

5.1.10 Verify that the L-19 marker stake is placed at a 200ft (60.96-m) interval grid point, by reading the northing and easting coordinates from the CSPCS coordinate mark.

5.1.11 Verify the northwest corner of the L-19 boundary by locating the grid marker stake directly north at M-19.

5.1.12 Lay a second 200-ft (60.96-m) measuring tape, starting at the L-19 southwest corner post along the line running due North, ending at the next marker stake (M-19). This line depicts the east boundary line of L-18, and the west boundary line of L-19.

5.1.13 Verify that the L-20 southeast marker stake is located at 200-ft (60.96-m) further east of the L-19 marker by reading the northing and easting coordinates from the CSPCS coordinate mark.

5.2 Locating the Survey Unit

NOTE: There is only one (1) Survey Unit, that covers both L-18 and L-19 geodetic grid block areas. It is necessary to establish the point of origin of the Survey Unit (SU) within the geodetic grid blocks, and begin measuring sample point locations within the SU area.

5.2.1 Identify the corner stakes and boundaries for the L-18 survey block. Use the measuring tapes to identify the SU location within the grid block, by measuring from the L-18 SW corner marker.

5.2.2 Mark the starting location of SU1 by measuring 120-ft (36.5-m) east from the southwest L-18 marker stake, measuring along the south boundary line of L-18 to L-19. This 120-ft (36.5-m) point becomes the southwest corner of the survey unit.

5.2.3 Mark the location 120-ft (36.5-m) north from the southwest corner location point established in step 5.2.2. This action will establish the west boundary line of SU1.

5.2.4 Mark the northeast end point location of SU1 by measuring 200-ft (60.96-m) east from the [northwest 120-ft (36.5-m)] location point established in step 5.2.3. This action will establish the north boundary line of SU1.

5.2.5 Mark the southeast end point location of SU1 by measuring 120 feet (36.5-m) south of the northeast end point location established in step 5.2.4. This action will establish the east boundary line of SU1. The southern boundary of the survey unit runs between the L-18 and L-19 markers. Refer to Step 3.4.2, Figure 2.

5.2.6 Establish a rope boundary around the survey unit.

5.3 Establishing Starting Coordinates and Spacing

NOTE: A minimum of 22 soil samples shall be taken in the Survey Unit.

5.3.1 Measure from the southwest corner origin of SU1, 141.5-ft (43.1-m) east across the southern boundary line. Mark this point.

5.3.2 Measure 51.1-ft (15.5- m) north from that point marked in step 5.3.1. Mark this coordinate point as the "random starting point".

5.3.3 Mark sample points every 33 feet (10 meters) apart within the SU until there are 22 sample points marked. Refer to Appendix G.

5.4 Ambient Gamma Survey

NOTE: (1) The ambient gamma survey is conducted at locations defined by the sample point locations within the Survey Unit.

5.4.1 Record the Southwest Corner Post ID data (L-18 or L-19) in the upper left-hand corner of the Ambient Gamma Survey Data Record. Include the Survey Unit number, and starting point coordinates of the SU.

5.4.2 Place the detector pole, with its mounted gamma detector, at the starting sample point location. The pole of this fixture will be held perpendicular with the gamma detector towards the ground surface.

5.4.3 Survey each sample point every 33-ft (10 meters) apart. Record the gamma measurements at each point.

NOTE: If unusual or anomalous meter behavior is observed, determine if the meters are functioning normally, and the meter cables are free of defective connections. Enter observations in the Survey Logbook, and report observations to the RSO at the end of the shift. If instrument operation remains suspect, report the problem to the Radiological Instrumentation Laboratory, and the Survey Team members before making any survey measurements with the instrument (s). If anomalous instrument behavior is observed, or if cables or batteries are replaced, or if any adjustments are made, enter a note on that instrument's IQR Data Sheet.

5.4.4 Record the survey point location data in the columns provided on the Ambient Gamma Survey Data Record. The data recorded is the measured tape distances northward and eastward from the southwest (SW) corner post.

5.4.5 Record the results, date and time on the Ambient Gamma Survey Data Record, and move to the next survey location.

5.4.6 Obtain at each sample point location, a 1-minute count of ambient gamma activity at 1-meter distance above the ground surface.

5.4.7 Record the results of the 1-minute count, the date and time next to the survey point location data on the Ambient Gamma Survey Data Record. In the "NOTES column, enter the meter numbers of the instruments used, and the initials of the person making the measurements.

5.4.8 Enter any observations about the environment (e.g. proximity to large rocks, temperature, weather, etc.), or instrument behavior that might lend perspective to the data during later analysis.

5.4.9 Mark the location as a potential hot spot if the measured gamma count rate exceeds 4300 cpm for further investigation.

5.4.10 Mark the location if high-count rates are measured and enter the location in the "NOTES" column of the Ambient Gamma Survey Data Record.

5.4.11 Enter Team HP initials in the space provided and sign at the bottom of the data record page. Sign and initial at the bottom of the data record page.

5.4.12 Ensure that the SU boundary markers are still secured when survey measurements are concluded and proceed to the walk-about survey.

5.5 Walk-About Survey

NOTE (1): The gamma detector mounted on the end of a balanced boom (the *Walk-About Survey Detector Fixture*), is used close to the ground surface while sweeping it side-to-side and walking. The walk-about survey of a SU can be performed after the ambient gamma survey is concluded.

(2): One east/west survey transect *measuring* tape can accommodate the walk-about survey.

5.5.1 Lay a transect tape 5ft north of the southwest corner SU post, on a line running due east. Lay the tape out to a point on the east boundary of the SU that is 5ft north of the southeast corner post. The survey transect tape provides a guide for keeping the transit line straight, and parallel to the south boundary, as the technician walks the transit path across the SU.

5.5.2 Record the transit being surveyed (identified by its distance north of the south corner posts) on the Walk-About Survey Transit Record.

5.5.3 Record the date and starting time for the transit.

NOTE: Starting at the southeast corner of the SU, the surveyor should face east, stand motionless, and slowly sweep the detector probe (as close to the ground as possible) across a 5-ft wide path. The speed of the sweep should be approximately 1 foot per second. After completing one 5-ft wide sweep, step forward 1 foot and repeat the 5 second sweep.

5.5.4 Pace forward to the eastern boundary of the SU repeating the 5 second sweep at each step.

5.5.5 Scan a 5ft-wide strip of the ground surface (immediately to the south of the transect tape) with the gamma detector, while monitoring for changes in the gamma meter count rate.

5.5.6 Note the approximate maximum and minimum count rate observed during the walk across the survey transit line, and approximate average count rate value for the whole transit pass (where the meter indicator spent most of its time during the transit pass). Estimates need only be to the nearest 200cpm.

5.5.7 Leave the east/west transit line, marking the point of departure from the transit line. If an increase in gamma activity is noticed, and not already marked as a *hot spot*, follow the direction of the increase until the location (source) of the increased gamma activity is found. If the gamma count rate exceeds 4300cpm, the surveyor will mark the potential *hot spot* location.

5.5.8 Record the location of any indicated *hot spot* in the Walk-About Survey Hot Spot Data Record. Determine the location of any suspected *hot spot* using the survey measuring tapes within the survey block. Record the location coordinates of any suspected *hot spot* in the columns provided.

5.5.9 Repeat steps 5.5.7 through 5.5.8 to determine the source of the high detector reading if a hot spot is detected. If a potential hot spot is detected, refer to Section 5.6.

5.5.10 Record the result of the measurement, meter number of the gamma instrument, initials of the person making the measurement, date and time in the Walk-About Survey Hot Spot Data Record.

5.5.11 Continue systematic scanning for more potential *hot spots* until the endpoint of the transit, at the eastern boundary tape is reached.

5.5.12 Record the time of transit end, estimate of the approximate maximum, minimum, and average count rate values (cpm), and HP Initials in the Walk-About Survey Transit Record. Sign and initial at the bottom of the transit record page.

5.5.13 Move the survey transect tape northward 5-ft to the next 5-ft transit line. Repeat the east/west transits, moving the transit line northward every 5-ft for each survey on the transit line after each pass across the SU until the gamma detector has been swept over the entire survey area.

5.6 Hot Spot Survey

CAUTION: If any locations in the SU were flagged as anomalous or, "suspect" during the ambient gamma survey, go directly to the area and record the survey unit ID number, and the SW corner post ID data on the Walk-About Survey Hot Spot Data Record. Record "suspect" locations in the NOTES column.

5.6.1 Scan the area around any potential *hot spot* locations to detect the source of the high or anomalous gamma activity readings that were observed in the ambient gamma survey. If an increase in gamma activity is noticed during this scan, the surveyor will follow the direction of the increase until the specific location of the gamma activity peak is found.

5.6.2 Determine the approximate gamma activity at the new peak location using the survey instrument at 1-meter height.

5.6.3 Place a marker (such as a numbered flag) at the new potential *hot spot* location. If this new location is clearly the source of the high gamma activity reading at the nearby gamma survey grid point, indicate it on the Hot Spot Data Sheet for this survey block.

5.6.4 Record the *hot spot* location (or marker flag number) in the left-hand column of the Walk-About Survey "Hot Spot" Data Record.

5.6.5 Determine the coordinate location of the *hot spot* within the SU using the measuring tapes. Record the coordinates of the *hot spot* in the columns provided in the Walk-About Survey "Hot Spot" Data Record.

5.6.6 Measure a 1-minute count of gamma activity at the contact surface of the potential *hot spot* location.

5.6.7 Record the results of the measurement in the Walk-About Survey Hot Spot Data Record.

5.6.8 Record the results of the measurement, the meter number of the instrument used, and the initials of the person making the measurement in the Walk-About Survey Hot Spot Data Record.

5.6.9 Enter Team HP Initials in the space provided, sign and initial at the bottom of the *hot spot* data record page. Sign and initial at the bottom of the *hot spot* data record page.

5.6.10 Move to the next "suspect" hot spot, and proceed until all "suspect" locations have been scanned.

5.6.11 Record the SU identification number and the SW corner post ID data on a Walk-About Survey Transit Record.

5.7 Sampling Preparation

NOTE: This section provides the detailed procedure, which must be followed, for soil sampling, as part of the 17th Street Drainage Area Final Status Survey Procedure. The total number of samples to be collected was determined through the MARSSIM statistical analysis. Twenty-two (22) soil samples will be taken at the survey sample point locations. Record observations and information, which may be pertinent to the interpretation of results of the soil, sample analyses (e.g. soil coloration, presence of foreign objects nearby, proximity to geological features, etc.).

5.7.1 Obtain the following soil sampling equipment and materials called out in Section 4.2, steps 4.1.12 through 4.2.15 of this procedure.

5.7.2 Enter the following soil sample information for each sample to be obtained. This information will be entered in the Field Logbook by the Health Physics technician.
- 5.7.1.1 Sample number (example: 17ST-0022)
- 5.7.1.2 Sample Location (example: SU1-N34/E43)
- 5.7.1.3 Sample Depth
- 5.7.1.4 Sample Date
- 5.7.1.5 Sample Personnel
- 5.7.1.6 Sample Description

5.7.3. Verify that all sampling equipment is clean. If the equipment is not clean, proceed to Section 5.10, Equipment Decontamination for decontamination.

5.7.4. Ensure the Field Logbook, Field Data Sheet, Chain of Custody Form, and radiation survey Form 732A are available.

5.7.5. Create seven columns in the Field Logbook for information identified in *Section 5.8*.

5.7.6. Identify the sampling point locations. Mark the locations with paint, flags, stakes, or other markers and note which sampling locations are inaccessible.

5.8 Soil Sampling

NOTE: Soil samples are taken at all 22 sample point locations. These samples will be sent off site for additional analysis.

5.8.1 Ensure all preparation steps have been completed in Section 5.7.

5.8.2 Remove any surface materials and vegetation from the soil sampling location.

5.8.3 Remove about a one kilogram (0-6 inches) deep soil sample at the sample point location using a hand shovel or hand auger with a clean sample collection tube attachment.

5.8.4 Transfer the soil from the hand shovel or hand auger to the plastic bag (double bagged for durability). If the bag has not been labeled, label it with the bag and building number.

5.8.5 Repeat steps 5.8.3 to 5.8.4 until adequate soil volume (1-kg or 2 auger tube volumes) is collected in the plastic bag (If the sample is a Quality Assurance sample, twice the sample volume is needed). The same sampling equipment can be used without decontamination.

5.8.6 Record sample information on the Field Logbook.

5.8.7 Thoroughly mix the sample in the plastic bag and remove as many rocks as possible.

5.8.8 Seal the plastic bag (minimize air in the bag) and transfer it to the transport container.

5.8.9 Decontaminate soil-sampling equipment according to Section 5.10 prior to sampling at the next sampling location.

5.8.10 Repeat steps 5.8.3 to 5.8.9 at the next sampling location.

5.9 Screening of Soil Samples

5.9.1 Measure the exposure rate of all samples using a micrometer. Record the results of the radiation screening for the shipping documentation.

5.9.2 Take an additional soil sample from one of the 22 sample points. Label it when shipped to the outside laboratory as "BLIND DUPLICATE" and do not indicate to the outside lab the origin of this sample. Send it along with the other samples to the outside laboratory. Record the origin in the logbook for the 17^{th} Street Area.

5.9.3 Take an additional soil sample in an area within the SU. Label this sample "MATRIX SPIKE". Send it along with the other samples to the outside laboratory. Ensure the lab is notified that a "spike" sample is included and requires testing along with the sample lot.

5.10 Equipment Decontamination

NOTE: Since decontamination of equipment is not easy, it is necessary to assume that all sampling equipment is contaminated until shown otherwise. The following steps shall be taken to clean and decontaminate sampling tools used in collecting soil samples. Sampling tools and sampling equipment include everything that could transfer contamination between samples (e.g., hand shovel, metal spatula, hand auger, power auger, etc.).

5.10.1 Set up cleaning buckets in the equipment cleaning area.

5.10.2 Add detergent and water to the wash bucket and allow the equipment to soak until all soil is soft. Scrub the equipment with a brush until clean. The cleaning solution may be reused unless too much soil has accumulated to be usable.

5.10.3 Using as little water as possible, rinse the equipment with water ensuring all rinse water drains into the rinse bucket.

5.10.4 Dry the equipment with clean paper towels. Collect them in a plastic bag and check the bag prior to disposal for contamination.

5.10.5 Check the equipment for contamination using a GM detector (frisker). If the scan indicates that the equipment is still contaminated, repeat the decontamination process until all equipment is clean.

5.10.6 Record the readings on a radiation survey Form 732A and record the data in the logbook.

5.11 Sample Transfer and Control

NOTE: Sample transfer and control involves documentation of the transfer of samples from the field to the laboratory. The Chain of Custody Form will be used to provide continuous documented responsibility for each sample sent for laboratory analysis. The laboratory takes custody of the sample by signing the chain of custody.

5.11.1 Notify the analytical lab engineer at Building 4100 laboratory of the number of samples to be analyzed and establish a schedule for transferring the samples to the lab.

5.11.2 Fill out laboratory analysis logbook to obtain a sample number.

5.11.3 Obtain and fill out and sign the chain of custody form.

5.11.4 Obtain, fill out and sign the container seal and label.

5.11.5 Place label on the container and affix a custody seal across the container lid.

5.11.6 Ensure the analytical lab engineer at Building 4100 signs the chain of custody form.

5.11.7 Verify a copy of the survey for the sample lot is attached to this procedure and provide the Radiation Safety Department with the originals for data analysis.

FHP: __________

5.11.8 Ensure the limit of shipment does not exceed 5μR/hr above background levels.

5.12 Shipping

NOTE: If the soil sample shipment is greater than the DOT limit of 1890 pCi/gm (70 Bq/g) total content, or exceed 5μR/hr to the outside of the shipping package, use Form **710-S1** instead of Form **45-L**. Include the survey Form 732-A, the Chain of Custody Letter, and Information Letter (IL). Notify Joyce Kucinkas at 586-7603, and Roger Marshall at 586-5329 that radioactive material requires shipping.

5.12.1 Prepare a Form **45-L** and an information letter (IL) cover sheet to the Transportation Department stating that the material does not meet the DOT definition of radioactive material for transportation purposes.

5.12.2 Attach the signed survey Form 732-A stating the material is less than 5μR/hr above background levels, and the Chain of Custody Letter to Form 45-L

5.12.3 Notify Joyce Kucinkas, at 586-6043 that a non-radioactive material shipment is prepared for shipping.

6.0 COMPLETION REVIEW AND APPROVAL

6.1 By my signature below, I verify that all steps called out in this Procedure are signed off and complete:

PIC: ______________________________ Date: __________

FHP: ______________________________ Date: __________

6.2 I have reviewed this Procedure and found it to be satisfactory.

Project Engineer: ______________________________ Date: __________

Quality Assurance: ______________________________ Date: __________

6.3 I verify this Procedure is acceptable and available for external use.

Radiation Safety______________________________ Date: __________

7.0 REFERENCES

7.1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997.

7.2 Rocketdyne Document N0010P000033, "Methods and Procedures for Radiological Monitoring"

7.3 Rocketdyne Form 732-A, Rev. 8-97, "Radiation Survey Report"

7.4 Rocketdyne Document N001OP000032, "Training Program for Radiation Protection and Health Physics Personnel"

7.5 Document ER-AN-0005, "Training Plan for Environmental Restoration of Radioactively Contaminated Facilities", original dated September 17, 1991

7.6 Rocketdyne Master Emergency Plan

7.7 Rocketdyne Document, SHEA-016779, "17th Street Drainage Area-Characterization Surveys and Excavation", John Shao, December 21, 1998.

7.8 Rocketdyne Report N001SRR140131, "Approved Sitewide Release Criteria for Remediation of Radiological Facilities at SSFL", February 18, 1999.

Appendix A

AMBIENT GAMMA SURVEY DATA RECORD

SURVEY BLOCK ID #__________
PAGE:_____of______

SURVEY BLOCK/SW CORNER POST ID:

SURVEY POINT LOCATION				AMBIENT GAMMA				
DISTANCE FROM SW CORNER				AT 1 METER HEIGHT				
NORTH	EAST	DATE	TIME	GAMMA1	GAMMA2	METER/ LOCATION NOTES	HP INIT'L	QA&T INIT'L

(SIGNATURES) HP:____________________ (INIT'L):__________ DATE:______________
____________________ __________ ______________
QA&T:____________________ __________ ______________

SSFL AREA IV
RADIOLOGICAL
CHARACTERIZATION
STUDY

APPENDIX B

17th Street Drainage Area Survey Training Requirements

Qualification/Training	[1]Course No.	Facility Mgr.	PIC	Mechs. & HP Techs	Rad. Safety	H&S	Env. Rem.	Others
Medical Surveillance:								
Radiation Dosimetry	-	-	X	X	X	[2]X	[2]X	[2]X
Respirator Qualified	-	-	X	X	-	-	-	-
Training:								
Radworker I Qualified	4013 5078	X	-	-	-	[3]X	[3]X	[3]X
Radworker II Qualified	4013 4071 4072	-	X	X	X	-	-	-
Haz. Mat'l Comm.	4010		X	X	X	X	X	X
[5]Half Mask MSA	1030	-	X	X	-	X	X	-
[5]Full Face Mask	1032	-	X	X	-	X	X	-
[5]Haz. Waste Pkg. & Trans.	4028-1	-	X	X	X	-	-	-
[5]Haz. Waste Handling	4004	-	X	X	X	-	-	-
[4]Fork Lift	2003	-	-	X	-	-	-	X

1. Course number from Technical Skills & Development Department.
2. Applies when entry into a radiation area is planned.
3. Applies when work in radiation area is planned.
4. Required for operators of equipment only.
5. As required.

Appendix C

Document Sign-Off Form

Name (signature)	SS#	Date	Verified (PIC)

Appendix D
Gamma Instrument Qualification Data Sheet

Radiation Safety Gamma Daily Instrument Qualification Report

Instrument Electronics				Radiation Detector			
Boeing #:		Mfgr. S/N:		Boeing #:		Mfgr. S/N:	
Mfgr.		Model:		Mfgr.		Model:	
				Det. Eff	%		

Calibration

Last Calibrated: ____________ Calibration Due: ____________

Field Check Source

Source I.D.: | Isotope | Activity

Instrument Qualification Data

		Shift Start		Mid-Shift		Shift End:		
Check Time:								
Scaler Diagnostic								
Initial								Limit
	Bat		V		V		V	5.4
	HV:		V		V		V	
	Thresh:		mV		mV		mV	
Background Response								
5 Min. Count 1			c/5m		c/5m		c/5m	
5 Min. Count 2			c/5m		c/5m		c/5m	
5 Min. Count Avg.			c/5m		c/5m		c/5m	
Check Source Response								
5 Min. Count			c/5m		c/5m		c/5m	
Expected Count			c/5m		c/5m		c/5m	

Completed By: ____________ Signature: ____________ Date: ____________

Project: ____________

APPENDIX E

[Red Line Signature Sheet]

I verify by my signature below that I have notified the PIC, RSO, OM, and PM (as appropriate) of my changes to this procedure.

NAME	SIGNATURE	WORK GROUP	DATE
________	________	________	________
NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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Appendix F
[ProcedureTailgate]

I verify by my signature below that I have read the 17th Street Drainage Area Procedure before conducting any work.

NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE
NAME	SIGNATURE	WORK GROUP	DATE

APPENDIX G

STARTING POINT COORDINATES AND SAMPLE POINTS

Survey Unit 200-ft by 120-ft (60.9-m by 36.5)
Sample points are 33-ft (10-m) distance apart